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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF APPEALS

APPEAL BRIEF FOR THE APPLICANTS

Kazuhisa TSUNOI, et al.

Serial No. 09/805,559

Field: March 14, 2001

Group Art Unit: 2815

Examiner: Joseph H. NGUYEN

P.T.O. Confirmation No.: 2664

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Date: May 4, 2004

Attorney Docket No.: **980404A**

**THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Appeal No:

In re the Application of: **Kazahisa TSUNOI et al.**

Group Art Unit: **2815**

Serial No.: **09/805,559**

Examiner: **Joseph H. NGUYEN**

Filed: **March 14, 2001**

P.T.O. Confirmation No.: 2664

For: **MOUNTING METHOD OF SEMICONDUCTOR DEVICE**

**BRIEF ON APPEAL**

Mail Stop Appeal Brief - Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Date: May 4, 2004

Sir:

Following the filing of the Notice of Appeal on March 4, 2004, the following is the Applicants' Appeal Brief. In accordance with 37 C.F.R. §1.192(a), this brief is being filed in triplicate. A check in the amount of three hundred twenty dollars (\$330.00) is included for the filing fee of this Appeal Brief.

**I. REAL PARTY IN INTEREST**

The real party in interest is Fujitsu Limited, 1-1, Kamikodanaka 4-chome, Nakahara-ku Kawasaki-shi, Kanagawa 211-8588, Japan.

**II. RELATED APPEALS AND INTERFERENCES**

There are no other related appeals of interferences.

**III. STATUS OF CLAIMS**

This is an appeal from the action of the Examiner, dated October 4, 2003, finally rejecting claim 6. Claim 6 is appealed and is set forth in the attached APPENDIX.

The claims and specification stand as amended by the filing of a Preliminary Amendment dated March 14, 2001, an Amendment Under 37 C.F.R. §1.111 dated February 26, 2002, an Amendment under 37 C.F.R. §1.116 dated August 1, 2002, an Amendment under 37 C.F.R. §1.111 dated December 16, 2002 and an Amendment Under 37 C.F.R. §1.111 dated July 31, 2003.

**IV. STATUS OF AMENDMENTS**

No amendments have been filed after the final rejection of October 4, 2003.

**V. SUMMARY OF THE INVENTION**

**One Embodiment of the Invention**

This invention relates to a semiconductor device having bumps and a board having pads so that each of the bumps is joined to a corresponding one of the pads, each of the pads per se having a deformed surface with which a corresponding one of the bumps contacts. An insulating adhesive is provided between the semiconductor device and the board such that it is in contact with each of the pads and bumps. The bumps of the semiconductor device are pressed on the pads of the board while the insulating adhesive is heated, wherein the insulating adhesive has a heating characteristic by which liquidity of the adhesive is produced by an initial heating stage and then is gradually hardened with an increase in temperature. Moreover, the bumps are pressed against the pads with

a contact pressure sufficient to provide plastic deformation of the bumps and the pads before the insulating adhesive is heated to a temperature at which the insulating adhesive is hardened. Further, each of the bumps has an end with a diameter smaller than other portions of the bumps so as to facilitate deformation of the pad when the bumps are pressed against the pads and to form a space in which the insulating adhesive is filled. After the deformation takes place, the temperature is increased further to where the insulating adhesive hardens and contracts, wherein such contraction maintains the pressure on the bumps and the deformed pads.

One detailed example of one embodiment of the invention is illustrated in Figs. 3 - 5 and described on pages 6 - 9 of the specification of this application. Referring to Fig. 3, the bump 36 is pressed onto the pad 34 by thermopressing head 30 which includes heater 301, wherein an adhesive 39 is applied between the bump 36 and the pad 34. Fig. 4 is a timing chart indicating a time variation of the temperature and pressure when the head 30 is pressed down onto the bump 36.

As illustrated in Fig. 4, the contact pressure PP on the bump 36 is gradually increased from 0 to a predetermined contact pressure PA during time t0 to time t1, when the head 30 is pressed down onto the bump 36. Also, during this time period of t0 to t1, the temperature of the adhesive 39 is gradually increased from room temperature RT.

At time t1, when the contact pressure PP reaches the predetermined contact pressure PA, the movement of the head is stop and its position is maintained. The value PA of the contact

pressure PP is set to a value sufficient to provide plastic deformation to the bump 36 and the pad 34. Thus, the bump 36 and the pad 34 are plastically deformed at time t1 before the temperature TT of the adhesive 39 reaches a hardening temperature HT.

That is, at time t3, the adhesive 39 starts to be heated at the hardening temperature HT. From the time t3, the adhesive is heated at the hardening temperature HT so it rapidly hardens and contracts, wherein such contraction maintains the pressure on the bump 36 and the deformed pad 34.

## **VI. ISSUES**

The issue presented for review before the Board in this Appeal is whether claim 6 is properly rejected under 35 U.S.C. §102(b) as being anticipated by Tokuno (U.S. Patent No. 5,892,289).

## **VII. GROUPING OF THE CLAIMS**

Claim 6 is considered to stand or fall together since it is the only pending claim.

## **VIII. ARGUMENTS**

Claim 6 is rejected under 35 U.S.C. §102(b) as being anticipated by Tokuno.

Claim 6 calls *a board having pads so that each of the bumps is joined to a corresponding one of the pads, each of the pads per se having a deformed surface with which a corresponding one of the bumps contacts.*

For example, as discussed in lines 2 – 12 on page 9 of the present specification, the surface of each of the pads 34 is deformed when the value PA of contact pressure PP caused by the bump 36 being pressed onto the pad 34 by the thermopressing head 30 reaches a value sufficient to provide plastic deformation to the bump 36 and the pad 34.

With regard to this claim feature, the Examiner asserts that “[I]t is inherent that the surfaces of the pads 4 in figure 1B of Tokuno are deformed when the bumps 3 are formed on the pads by thermal pressure bonding (col. 6, lines 17-18).”<sup>1</sup>

It is respectfully submitted that lines 17-21 of column 6 of Tokuno recite “in place of Ag-Sn type solder, a connecting structure which directly connects, by thermal-pressure bonding, the gold ball bump onto the mounting pad 4 of the substrate 2, and it is also possible to use Pb-Sn type solder or indium type solder as the material for the bump 3.”

However, based on the above, it appears that while the bump 3 may be deformable there is absolute no support for the mounting pad 4 to be deformable as well. That is, the Examiner has

failed to provide any rationale or evidence supporting his position that it is inherent in the “thermal pressure bonding” disclosed by Tokuno that the surfaces of the pads 4 are deformed.

In other words, it is submitted that the Examiner has failed to provide objective evidence or cogent technical reasoning to support the conclusion of inherency.

Moreover, it is respectfully submitted that it is an object of Tokuno to relieve the stress occurring in the bump connection parts. More specifically, according to Tokuno, “as shown in Fig. 2 (C), the form of the resin seal after completion of the sealing enables relief of concentrated stress which occurs at the bump connection part of the four corners of the semiconductor chip 1 ... thereby improving the reliability of the connection at the bump connection part,”<sup>2</sup> and “[t]he reason for this is that resin fillets [50] at the four corners of the semiconductor chip 1 are large, and therefore are able to relieve stress occurring in the bump connection parts.”

Thus, it is respectfully submitted that it is illogical that it is inherent in Tokuno to apply enough pressure at the bump connection parts to deform the pads 4 when it is an object of Tokuno to actual relieve the stress occurring between the bump 3 and the pads 4.

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<sup>1</sup> Please see, lines 1 – 2, page 2 of the Advisory Action dated March 17, 2004.

<sup>2</sup> Please see, lines 54 – 60, column 4 of Tokuno.

Claim 6 also calls *an end of each of the bumps has a diameter smaller than other portions of the bumps so as to facilitate deformation of the pad when bumps are pressed against the pads and to form a space in which the insulating adhesive is filled.*

As discussed above, Tokuno fails to disclose that the pads 4 are deformable. Thus, clearly, Tokuno fails to disclose or fairly suggest these features of claim 6 concerning *an end of each of the bumps has a diameter smaller than other portions of the bumps so as to facilitate deformation of the pad when bumps are pressed against the pads and to form a space in which the insulating adhesive is filled.*

Finally, claim 6 calls for *contraction of the insulating adhesive maintains joints of the bumps and the pads, said joints being made by deformation of the pads.*

For example, as shown in the timing diagram of Fig. 4 of the present application, the bump 36 and the pad 34 are plastically deformed at time t1 before the temperature TT of the adhesive 39 reaches a hardening temperature HT. Then, at time t3, the adhesive 39 is heated at the hardening temperature HT so it rapidly hardens and contracts, wherein such contraction maintains the pressure on the bump 36 and the deformed pad 34.

However, Tokuno fails to disclose contraction of the sealing resin 15 which maintains pressure on the bump 3 and pad 4. Instead, Tokuno discloses in Fig. 2B that the sealing resin 15 is



introduced at the four corner portions 11 to 14 and expands or flows inward there from, as indicated by reference numeral 6 which depicts the direction of flow of the sealing resin.

Therefore, it is clear that Tokuno fails to disclose or fairly suggest the features of claim 6 concerning *contraction of the insulating adhesive maintains joints of the bumps and the pads, said joints being made by deformation of the pads.*

## **IX. CONCLUSIONS**

As set forth above, it is respectfully asserted that the prior art fails to teach or suggest the recitations of the claim. The Applicants respectfully request the Board to reverse the Examiner's rejections and allow this application to issue.

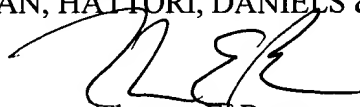
**BRIEF ON APPEAL**

**SERIAL NO.: 09/045,115**

In the event this paper is not timely filed, Appellant hereby petitions for an appropriate extension of time. The fee for any such extension may be charged to our Deposit Account No. 50-2866, along with any other additional fees which may be required with respect to this paper.

Respectfully submitted,

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Enclosure: Appendix



BRIEF ON APPEAL

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## X. APPENDIX

### CLAIMS ON APPEAL

#### Listing of Claim:

Claim 6 A structure comprising:

a semiconductor device having bumps:

a board having pads so that each of the bumps is joined to a corresponding one of the pads, each of the pads per se having a deformed surface with which a corresponding one of the bumps contacts; and

an insulating adhesive provided between the semiconductor device and the board, and in contact with each of the pads and bumps wherein

an end of each of the bumps has a diameter smaller than other portions of the bumps so as to facilitate deformation of the pad when bumps are pressed against the pads and to form a space in which the insulating adhesive is filled, and wherein

contraction of the insulating adhesive maintains joints of the bumps and the pads, said joints being made by deformation of the pads.